AQUATIC PLANT
AND
ALGAE CONTROL

ONTARIO MINISTRY OF THE ENVIRONMENT

ONTARIO MINISTRY OF NATURAL RESOURCES

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1 INTRODUCTION

Aquatic plants are a natural part of a healthy aquatic ecosystem. They will grow wherever adequate sunlight, and suitable nutrients and water quality conditions exist.

Aquatic plants are beneficial. They augment natural dissolved oxygen levels, bind available plant nutrients, and provide food and habitat for many aquatic organisms. They provide protective cover for fish, waterfowl, amphibians, reptiles and other marsh dwellers, and they also camouflage nesting sites. In addition, their seeds and tubers provide a source of food for waterfowl and other herbivores.

In excessive amounts, however, aquatic vegetation can have a detrimental effect on the ecosystem. Algal "blooms", or dense submerged plant communities, can create such large daily fluctuations in the dissolved oxygen levels in the water that fish may die. In many recreational lakes in Ontario, dense stands of aquatic plants, such as Eurasian water milfoil, pose a major deterrent to recreational use, particularly for activities such as swimming, boating and water skiing.

2 TYPES OF AQUATIC PLANTS

2.1 Algae

Single-celled algae are the simplest plant forms that live in a water environment. Each cell is a complete plant in itself. Rapid increases in numbers occur by division of each cell, assuming that nutrients such as phosphorus and nitrogen are available. Such nutrients may be introduced into the water naturally (through the decomposition of grass clippings, leaf matter, or large aquatic plants) or artificially (through the leakage of a faulty septic system or the run-off and seepage from farm livestock operations).

Filamentous algae, in contrast, consist of a series of cells joined end to end. As with single-celled algae, these must be examined under a microscope for accurate identification.

Early in the spring, filamentous green algae may grow prolifically in ponds, but often die back naturally when the surface water temperature exceeds species' tolerance. After

an algicide application, the duration of control of nuisance filamentous algae varies with pond flushing rates and the potential for re-invasion from upstream sources. Cladophora, a branched filamentous green alga, is a problem in many beach areas of the Great Lakes, including Lake Huron, Lake Erie, and Lake Ontario. Plant filaments, growing on rocks underwater, are broken off and washed up in large quantities on the beaches. Decomposition of this debris often causes offensive odour problems.

Chara and Nitella are filamentous algae that are often mistaken for submergent vascular plants. In these plants, the cells incorporate calcium carbonate from the water into the cell wall to give rigidity. There is sufficient calcium carbonate to leave a white powder when the plants are removed from the water and dried. Chara is a problem in many hardwater trout ponds where it may grow, under suitable conditions, up to 3-4 m in length. Since it does not have a true vascular system, systemic herbicides, often mistakenly selected for use, do not work. Since each filament fragment can regenerate into a new plant, re-invasion, following fragmentation during mechanical removal, can also be a problem.

Under suitable conditions, many species of algae can multiply rapidly and form algal "blooms". Blooms of the blue-green algae, Microcystis, have been known to cause the death of cattle when contaminated water was used for livestock watering, due to an abnormally high concentration, in the water, of the toxins that are secreted naturally by these cells.

2.2 Submergents

Pondweed, Eurasian water milfoil and Tape grass are three of the more common submergent aquatic plants found in Ontario.

In the past, where susceptible species of submergents have been treated with herbicides, dominance in the plant community has shifted towards Tape grass, which is resistant to currently available aquatic herbicides.

2.3 Emergents

Cattails, bulrushes, pickerelweed, duckweed, and the water lilies, are some of the common emergent aquatic plants found in Ontario.

Better aquatic plant management may be achieved by integrating herbicide application with habitat alteration (see 4.1) to prevent re-invasion.

3 EURASIAN WATER MILFOIL

Many of today's problems in environmental management relate directly to the presence of exotic imports. These are non-native plants or animals that have been introduced intentionally or accidentally by man.

In Canada, the best known aquatic invader is Eurasian water milfoil. This native of Europe and Asia was found in 1902 in Chesapeake Bay, Maryland, and has since spread throughout North America. Its first recorded presence in Canada is a specimen collected from Rondeau Provincial Park in 1961. The plant was not widely recognized as a nuisance until the early 1970's when it became troublesome in the Kawartha Lakes in Ontario, and in Quebec and British Columbia.

Eurasian water milfoil is an extremely aggressive plant that reproduces largely by fragmentation, followed by regrowth, and soon crowds out the native plants. It can invade water from 1 to 10 metres deep. When the stems reach the surface, canopy formation occurs through profuse branching. In temperate climates, the plant exhibits a rapid growth phase in early spring, generally reaching the water surface by mid to late June, and causes severe interference with recreational use. Since it can thrive under a variety of environmental conditions, it is now widespread in Ontario, except in the soft-water Precambrian Shield lakes.

4 CONTROL METHODS

With any pest, it is imperative that the problem is properly identified before a control method is selected.

If you have any doubts about the identity of your pest plants, please contact the nearest Pesticides Control Office of the Ontario Ministry of the Environment (See Page 12).

There is no simple or single answer to aquatic vegetation control. When considering weed control measures for lakes where aquatic plants interfere with recreational use, primary consideration should obviously be given to rectifying the main cause of the problem, for example, by reducing the amount of nutrients entering the water.

A wide range of control measures including habitat manipulation, biological control, mechanical harvesting and chemical control, have been practised around the world with variable success. A careful assessment of various techniques, and of the value of the presence or absence of aquatic plants in a particular situation, should be made before any attempt at control is undertaken.

4.1 Habitat Manipulation Techniques

The objective of habitat manipulation is to alter one or more of the physical or chemical factors critical to plant growth. For example, the use of dyes or sheets of black plastic or other screening material reduces light penetration and thereby reduces plant growth. Covering the lake bottom with 15 to 20 cm of sand may be an effective method of physically altering the substrate. A sheet of dark, heavy-duty, construction polyethylene placed below the sand blanket will have the effect of both curtailing the transport of nutrients from the lake bottom, and of preventing the sand from sinking into soft sediments.

Dredging can be used to deepen a body of water, thus reducing the areas which can be colonized by plants. Dredging may also remove nutrient-rich sediments and alter the texture of the substrate, particularly in areas where silting has covered sterile sand or gravel bottoms.

Another habitat manipulation method that has been used with variable success is overwinter drawdown. This technique consists of lowering the water level to expose the plants to freezing and desiccation. However, its use for Eurasian water milfoil control in the Kawartha Lakes has been assessed in detail and found to be of questionable value.

4.2 Biological Control Methods

Biological control involves the use of a biological agent to control an undesirable pest species. It can be an inexpensive alternative to the often costly methods of chemical or mechanical control.

However, these biological agents (fish, pathogens, insects, etc.) are, of necessity, exotic imports and, in view of past mistakes, there is a general reluctance to use these techniques on a wide-scale basis.

Currently the use of biological control agents is in its infancy, and must be approached with caution to avoid the possibility of substituting one pest with another.

4.3 Mechanical Control

One of the oldest techniques for the control of aquatic vegetation is mechanical removal. Mechanical removal equipment ranges from chains dragged along the bottom to uproot vegetation, to small, inexpensive, boat-mounted cutters, and large sophisticated machines capable of cutting and collecting the plants for shoreline disposal. The use of mechanical methods for clearance of small areas (e.g., swimming beaches) is rather impractical since the use of small cutters or chains requires intensive manual labour to remove the vegetation from the water. Failure to remove the uprooted plants or cuttings can create oxygen depletion problems through decomposition of the vegetation, and can encourage the spreading and re-rooting of plant fragments.

On the other hand, for large-scale projects that use the larger automated machines, mechanical harvesting has been advocated as an environmentally sound approach. Vast quantities of plant material containing nutrients (e.g., nitrogen and phosphorus) can be removed from the waterways without significantly affecting the fisheries or the food web on which the fish depend.

For additional information on harvesting techniques, guidelines and equipment

manufacturers, contact the nearest Pesticides Control Office of the Ontario Ministry of the Environment (see page 12).

4.4 Chemical Control

Chemical control has been commonly used throughout North America for several decades. The mode of action of herbicides is quite specific. It is essential, therefore, to identify the nuisance plants, prior to treatment, to ensure that the herbicide selected for use will provide effective control. It is important to remember that a herbicide treatment may result in the release of nutrients into the aquatic environment when the plants decompose, resulting in severe algal "blooms". Generally, herbicides are most effective for weed control in small plots, where such pronounced secondary effects will not occur.

In Ontario, a permit system restricts excessive and indiscriminate use of herbicides. Herbicides that are authorized for use have been stringently tested for safety and efficacy, and have been specifically registered for aquatic use by Agriculture Canada, under the Pest Control Products Act. Recommendations on aquatic herbicide usage are published annually in the Ontario Ministry of Agriculture and Food (OMAF) Publication #75, entitled "Guide to Chemical Weed Control". This publication can be obtained from any of the offices listed on page 12.

Not all species of aquatic vegetation in lakes can be controlled by currently registered herbicides. Muskgrass, Tape grass, and the filamentous green algae Cladophora, are three examples of aquatic plants that are resistant to herbicidal activity. When resistant and susceptible plant species are present and create a problem, an integrated management scheme must be sought, rather than one using pesticides alone.

5 PESTICIDES LEGISLATION

The Pesticides Act, Subsection 5(1), provides that "no person shall engage in, perform, or offer to perform an extermination except under and in accordance with a licence of a prescribed class ... unless exempt under the regulations." In essence, a water exterminator's licence (Class 1 or Class 3

endorsed) is required by anyone applying a pesticide to water for algae or aquatic plant control, other than on his own domestic premises.

In addition, Subsection 7(2) provides that "no person shall perform a water extermination unless he is the holder of a permit issued by the Director [under the Act] for the water extermination or he is exempt under the regulations". Thus, a person requires a permit for the use of an aquatic herbicide where the treated water will move from the site of application to a lake, stream or other public water course by any means other than by percolation through the soil.

For example, a cottage association proposing to control submergent aquatics in a bay or lake area fronting numerous cottages will require a licence and a permit. One cottager treating his own cottage frontage will require only a permit. A municipality treating drainage ditches for control of emergent vegetation in the fall, when the ditches contain no moving water, will require only a licence.

Further information concerning licence applications, training sessions and examination requirements can be obtained from the Agricultural and Industrial Chemicals Section, Ontario Ministry of the Environment, Suite 100, 135 St. Clair Avenue West, Toronto, or the Regional or District pesticides specialist (see list on page 12). The licensing system ensures that people are educated on the safe storage, handling, and use of a pesticide, and on the impact of the chemical on the aquatic environment.

<u>A permit to perform a water extermination is issued for one year only</u>, and ensures that there will be no unreasonable infringements on the rights of other water users. It also ensures that the pesticide will not be toxic to humans, fish, domestic animals, or wildlife, provided it is used at the correct rate. Through the permit system, the area of vegetation treated in any one lake is regulated so that important fisheries and other wildlife habitats will not be significantly affected. To obtain a permit for applying a chemical or other substance to control nuisance conditions in any area of water, an individual or commercial agency must submit an application form (Form 7), so that the nature of the project and possible consequences arising from it can be evaluated. These application forms may be obtained by writing to the Regional or District Offices of the Ontario Ministry of the Environment (listed on page 12).

An application should be submitted well in advance of the time that the chemical is to be applied. While every effort is made to process applications as quickly as possible, six weeks may be required for the issuance of a permit, since it is necessary to correspond with the appropriate District Office of the Ontario Ministry of Natural Resources concerning the proposed treatment, and it may also be necessary to investigate the treatment site.

The acquisition of a permit or a licence does not divest any individual or commercial applicator of the responsibility for any undesirable consequences arising from a treatment. Anyone applying any substance without the authority of a licence or permit, or violating the terms and conditions provided in a permit, is guilty of an offence under the Pesticides Act and Regulation and, upon summary conviction, is liable to a fine.

All applications for a permit to perform a Water Extermination are reviewed by staff from the Ontario Ministry of the Environment and the Ontario Ministry of Natural Resources. If valid scientific reasons exist, the Director under the Pesticides Act may deny the permit or impose certain conditions. The permit applicant may appeal by contacting the Director and may request a hearing before the Environmental Appeal Board.

Aquatic herbicides for public water treatment cannot be purchased without prior receipt of an approved permit to perform a water extermination. The permit limits the amount of pesticide that may be purchased. This restriction on the availability of aquatic herbicides has served to prevent individuals from using herbicides indiscriminately, either without proper authorization or at excessive rates. The generally perceived concept of "the more the pesticide the more effective the control" is <u>NOT</u> an environmentally safe or economic practice.

6 HERBICIDE CALCULATIONS

In order to calculate the amount of herbicide required for a treatment, it is essential to calculate, as accurately as possible, the surface area of the body of water to be treated. If the application rate for a herbicide (as given on the label) is stated in "kg/ha" (kilograms per hectare)

or L/ha (litres per hectare), then the amount of herbicide to be used can be calculated by multiplying the surface area (in hectares) by the application rate (in either kilograms or litres per hectare).

EXAMPLE 1

You want to control, (using Reglone A), the growth of Eurasian water milfoil in a 40 metre by 25 metre area in the lake in front of your cottage.

a) Determine the application rate by reading the Reglone A label (or by referring to Ontario Ministry of Agriculture and Food Publication #75). The application rate is 11L/ha.

b) Determine the surface area of the water to be treated, in hectares.

Surface area = length x width
= 40 m x 25 m
= 1000 m^2
= 0.1 hectare (ha)

c) Calculate the amount of Reglone A required.
Amount required = surface area x application rate
= 0.1 ha x 11L/ha
= 1.1L

Therefore 1.1L of Reglone A is required.

NOTE: It is essential to use the correct application rate, in order that the correct amount of herbicide is applied. Product labels and Ontario Ministry of Agriculture and Food Publication #75, entitled "Guide to Chemical Weed Control", may give both a product application rate and an active ingredient application rate. All calculations should be made using the product application rate.

If the application rate for a herbicide is given as weight or volume per volume of water, then the volume of water to be treated must be calculated before the amount of herbicide to be used can be ascertained (see Example 2).

EXAMPLE 2

To treat a roughly circular pond, 50m in diameter, with Simmaprim 80W for the control of filamentous algae, the amount of Simmaprim 80W required can be calculated as follows:

The surface area of a circle is equal to πr^2, where $\pi = 3.14$, and r is the radius of the circle.

$\therefore$ the surface area of the pond

$= \pi r^2$

$= 3.14 \times 25m \times 25m$

$= 1{,}962.5m^2$

The volume of water to be treated is calculated by multiplying the surface area times the average depth. Therefore, if the average depth of the above pond is 2.0m, the volume of water is equal to

$1{,}962.5m^2 \times 2m = 3{,}925m^3$

Since $1m^3 = 1{,}000L$

the volume of water $= 3{,}925m^3 \times 1{,}000L/m^3$

$= 3{,}925{,}000L$

Therefore, the amount of Simmaprim 80W required (application rate = 9.7g/10,000L of water) is equal to

application rate x volume

$= 9.7g/10{,}000L \times 3{,}925{,}000L$

$= 3{,}607.25g$

$= 3.6$ kg

Table 1 lists some common conversion factors:

TABLE 1

1 yard = 0.91 m
100 m x 100 m = 10,000 m^2 = 1 ha
1 $m^3 \approx$ 1000 L
1 ha $\approx$ 2.5 acres
1000 g = 1 kg

Legend:
m = metres
m^2 = square metres
m^3 = cubic metres
ha = hectares
g = grams
kg = kilograms
L = litres

A more complete list of application rates and conversion factors (e.g., metric/imperial) for aquatic herbicides that may be used in Ontario is published annually in OMAF Publication #75, Guide to Chemical Weed Control. This publication may be obtained through any of the Ontario Ministry of the Environment offices listed on page 12.

ONTARIO MINISTRY OF THE ENVIRONMENT
PESTICIDES CONTROL OFFICES

COUNTY	DISTRICT	TELEPHONE
Essex, Kent, Lambton	H.E. Collins P.O. Box 726, 435 Grand Ave.W. Chatham, Ontario N7M 5L1	519-354-2150
Elgin, Middlesex, Oxford	D.C.Morrow & W.Lampman 985 Adelaide St.S. London, Ontario N6E 1V3	519-681-3600
Haldimand, Norfolk, Niagara, Hamilton, Wentworth	J.Percy Ontario Government Building 119 King St. W. Hamilton, Ontario L8N 3Z9	416-521-7640
Dufferin, Wellington, Waterloo, Brant	R. Miller Ontario Government Building 119 King St. W. Hamilton, Ontario L8N 3Z9	416-521-7640
Bruce, Grey, Huron, Perth	B.T. Lobb 20 King St., Box 688 Clinton, Ontario N0M 1L0	519-482-3428
Simcoe, Muskoka	W.J. Cowie 12 Fairview Road Barrie, Ontario L4N 4P3	705-726-1730
Halton, Peel, York, Durham, Toronto	T.O'Neill & D.Trenholm 7 Overlea Blvd., 4th floor Toronto, Ontario M4H 1A8	416-424-3000 (ext.204)
Peterborough, Victoria, Haliburton, Northumberland	A.G. Carpentier 139 George St. N. Peterborough, Ontario K9J 3G6	705-743-2972
Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville	D.A. Raddon 133 Dalton Ave., Box 820 Kingston, Ontario K7L 4X6	613-549-4000
Prescott & Russell, Renfrew, Stormont, Dundas & Glengarry, Ottawa-Carleton, Lanark	R.P. Cameron 2378 Holly Lane, Suite 204 Ottawa, Ontario K1V 7P1	613-521-3450
Manitoulin, Nipissing, Parry Sound, Sudbury	D.J. Mewett Northgate Square 1500 Fisher St. North Bay, Ontario P1B 2H3	705-476-1001
Cochrane, Timiskaming, Algoma	P. McCubbin 83 Algonquin Blvd. W. Timmins, Ontari P4N 2R4	705-264-9474
Kenora, Rainy River, Thunder Bay	G.R. Gammond Ontario Government Building 435 James St. S. Thunder Bay "F", Ontario P7E 6E3	807-475-1305

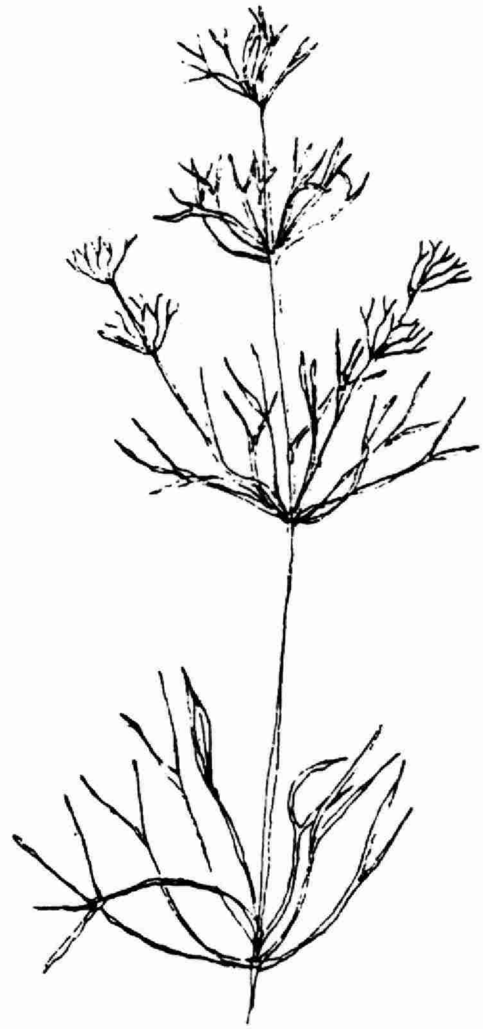
PLANT-LIKE ALGAE

MUSKGRASS

Chara vulgaris

½ - 1 x actual size

- can grow up to 4 metres in length
- lime green - grey green
- rough, coarse, gritty to the touch
- strong musk odour
- dries to white powder when removed from water
- attached to the bottom
- usually less than 0.75 metres high
- orange fruiting bodies may be present
- very often a problem in hard water ponds

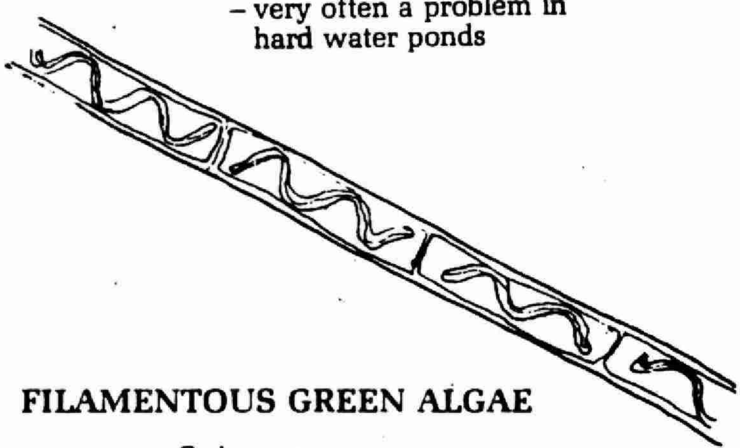


STONEWORT

Nitella sp.

3 x actual size

- much like Chara but smooth to the touch
- does not dry to a white powder when removed from water



FILAMENTOUS GREEN ALGAE

Spirogyra sp.

125 - 250 x actual size

- green hair-like filaments
- slimy to touch
- often attached to rocks

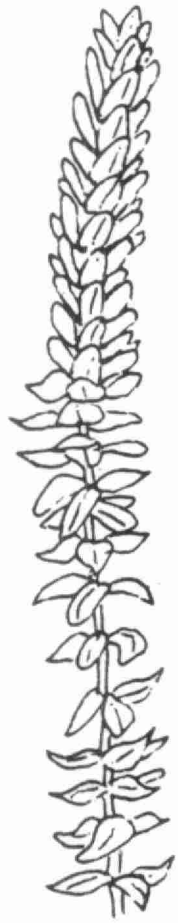
SUBMERGED VASCULAR AQUATIC PLANTS

PIPEWORT

Eriocaulon sp.

½ x actual size

- leaf rosette about 8 cm. diameter
- button-like white flowers on straight stalk above surface of water
- fibrous white root



CANADA WATER WEED

Ancharis canadensis

(ELODEA)

actual size

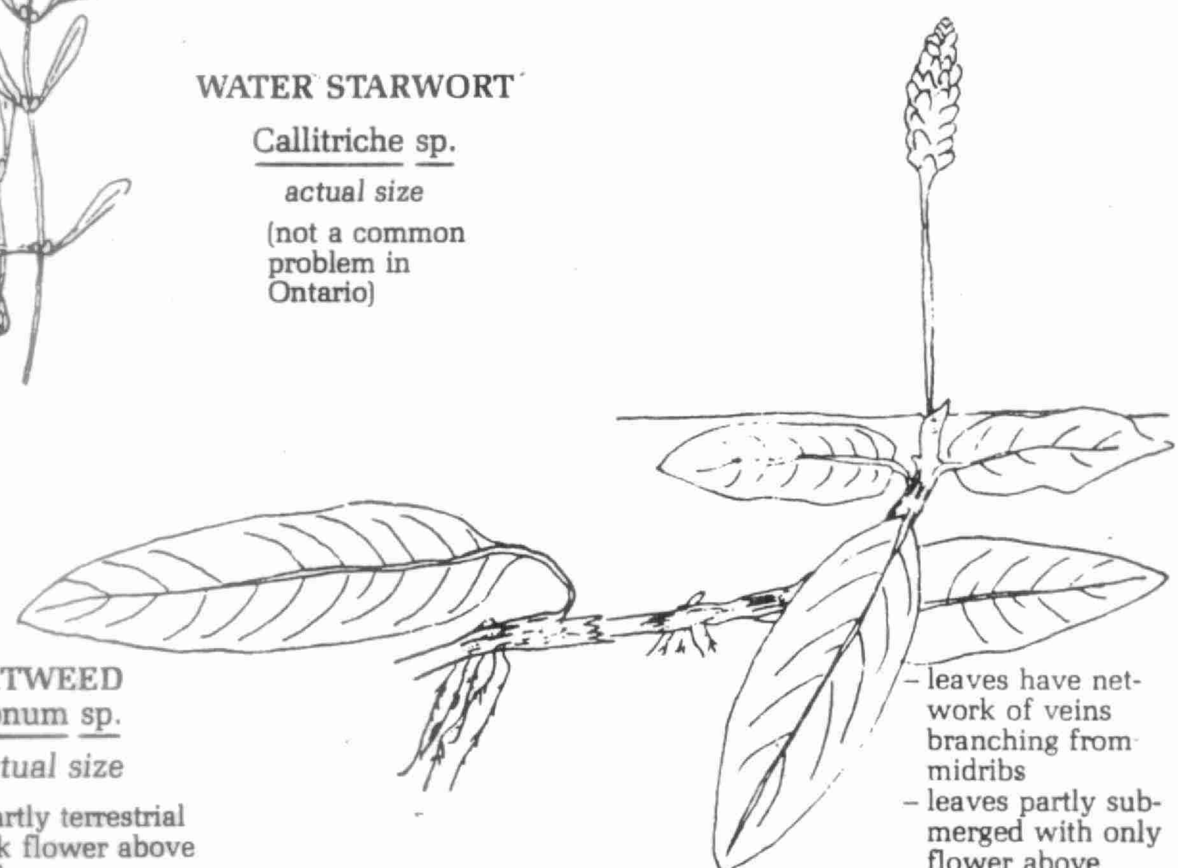
- *may or may not be rooted*
- *entirely submerged except in flower (white or pink)*
- *stem often branched*
- *base of leaf embraces stem*
- *clusters of 4 small leaves around main stem*
- *leaf margin has microscopic teeth*

WATER STARWORT

Callitriche sp.

actual size

(not a common problem in Ontario)



SMARTWEED

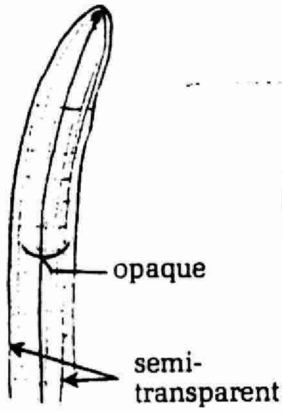
Polygonum sp.

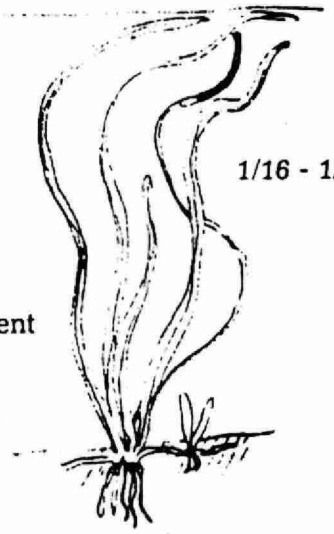
½ x actual size

- may be partly terrestrial
- bright pink flower above water surface

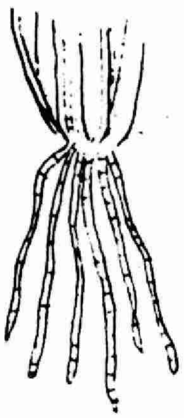
- leaves have network of veins branching from midribs
- leaves partly submerged with only flower above water surface

SUBMERGED VASCULAR AQUATIC PLANTS





1/16 - 1/4 x actual size



actual size

TAPE GRASS (WILD CELERY)

Vallisneria americana

- leaves ribbon-like, up to one metre or more in length
- short flared root
- tiny white flower at surface on coiled stem
- long pod-shaped fruiting body
- new plants grow at nodes along buried stems

WATER MILFOIL

Myriophyllum sp.

actual size

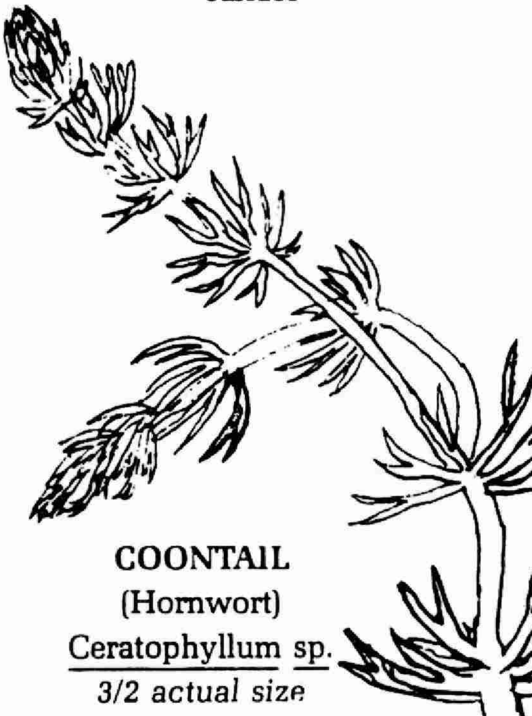
- four feathery leaves at each stem nod
- each leaf symmetrically subdivided
- many stems from 1 root; stems may be branching
- there are a number of native and exotic species
- small flowers in spikes above water surface

BLADDERWORT

Utricularia vulgaris

actual size

- asymmetrical branching
- tiny bladders easily recognizable
- can grow as long as 0.5 metre



COONTAIL

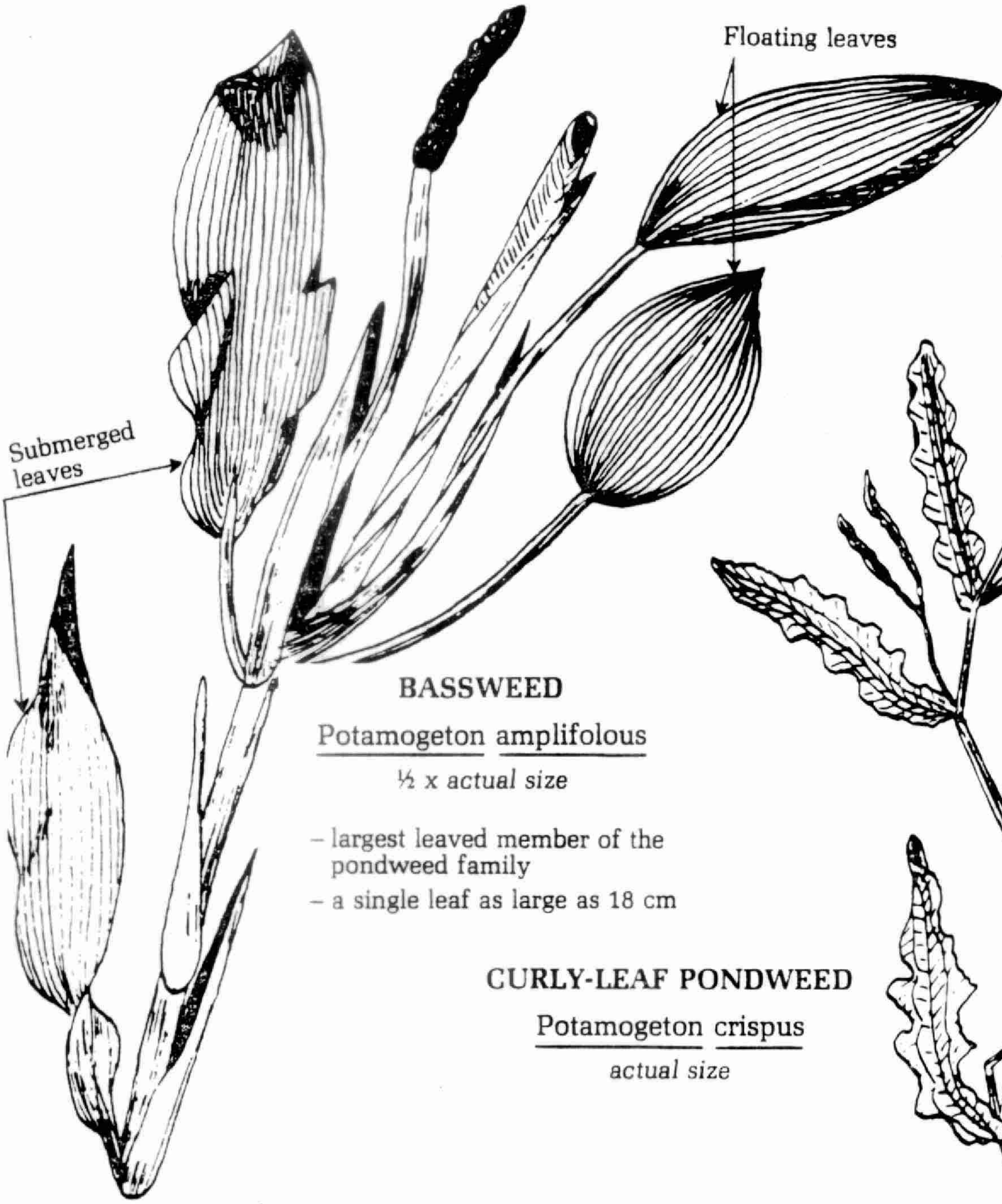
(Hornwort)

Ceratophyllum sp.

3/2 actual size

- plants entirely submerged, no roots, sometimes stem is embedded in the muddy bottom
- paired leaflets grouped at regular intervals along stem
- stem may be branched
- usually heavy concentrations of leaflets at apex

SUBMERGED VASCULAR AQUATIC PLANTS

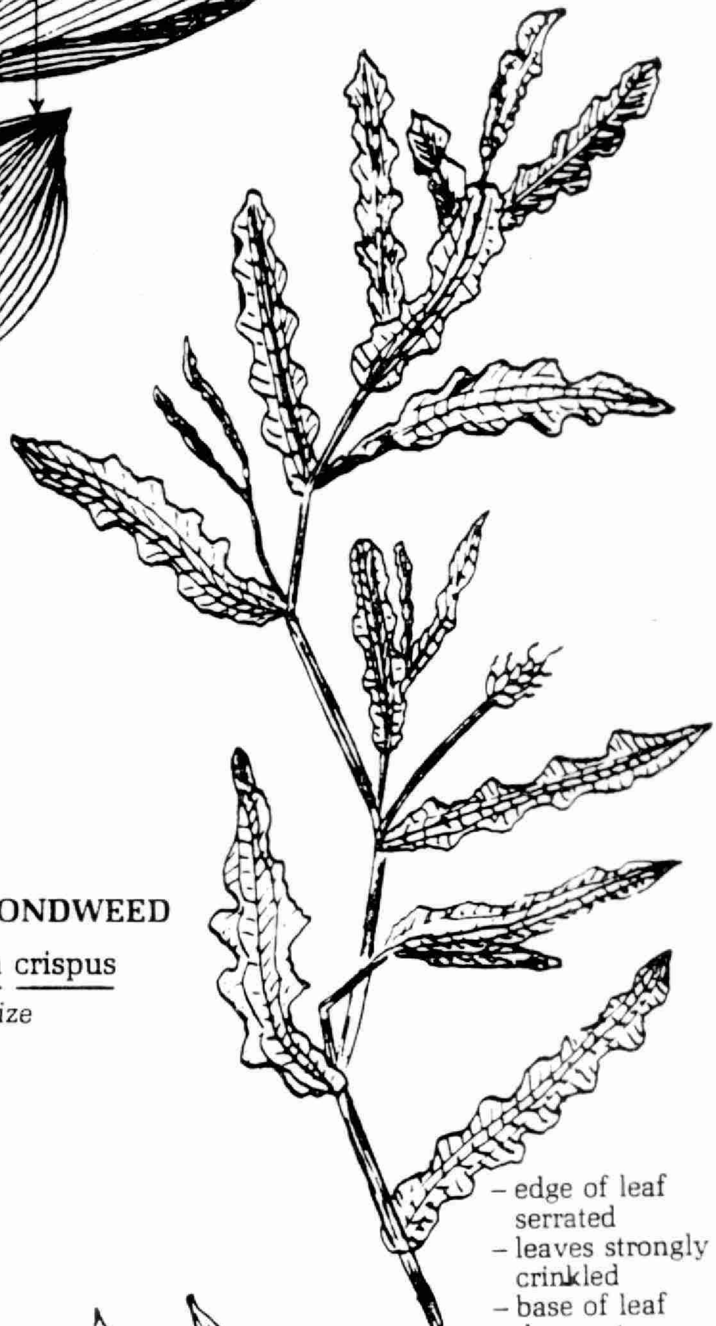


BASSWEED

Potamogeton amplifolous

½ x actual size

- largest leaved member of the pondweed family
- a single leaf as large as 18 cm

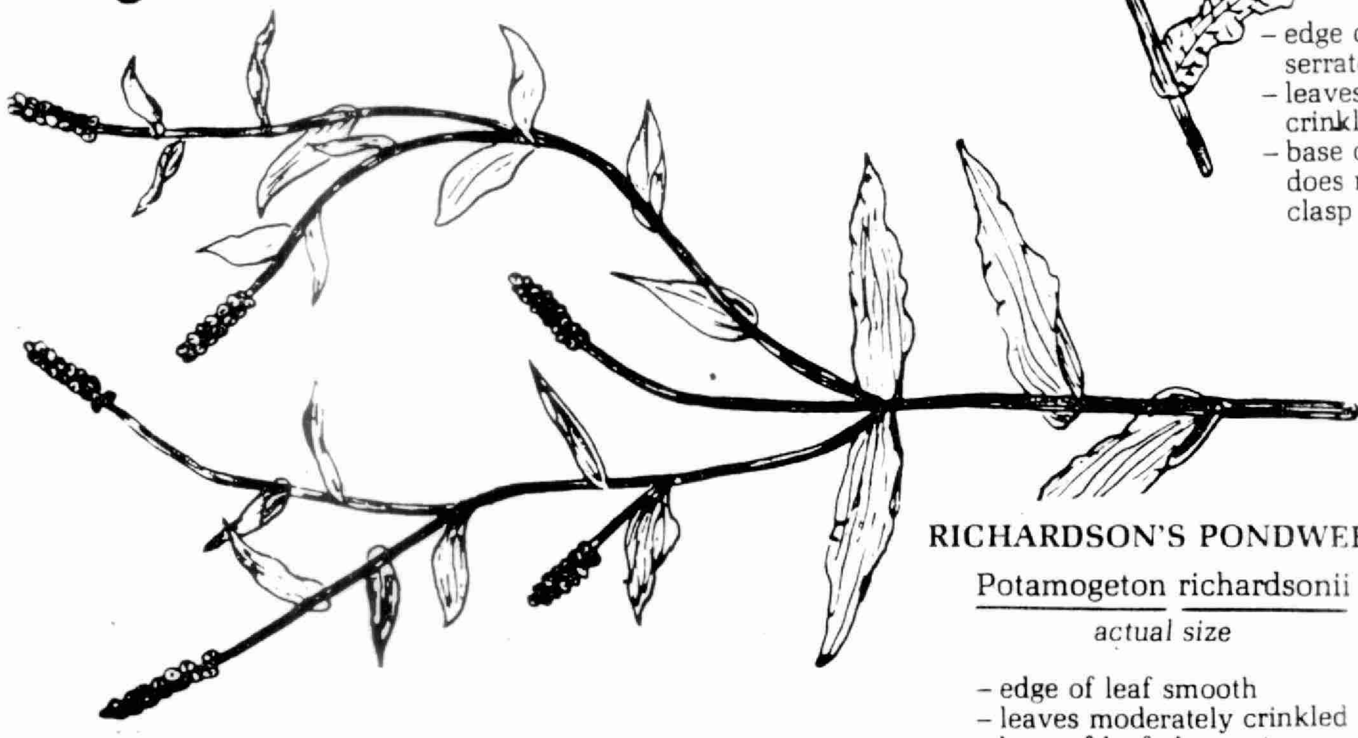


CURLY-LEAF PONDWEED

Potamogeton crispus

actual size

- edge of leaf serrated
- leaves strongly crinkled
- base of leaf does not clasp stem



RICHARDSON'S PONDWEED

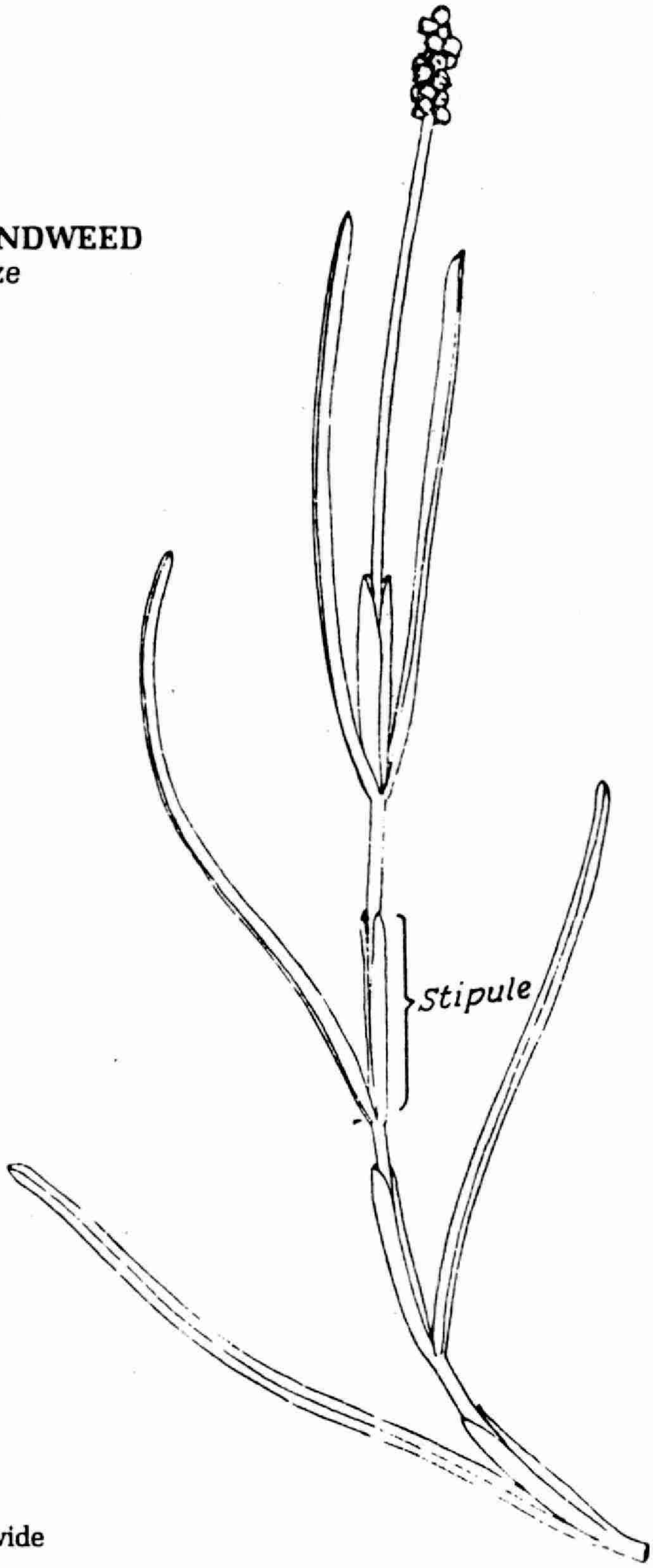
Potamogeton richardsonii

actual size

- edge of leaf smooth
- leaves moderately crinkled
- base of leaf clasps stem

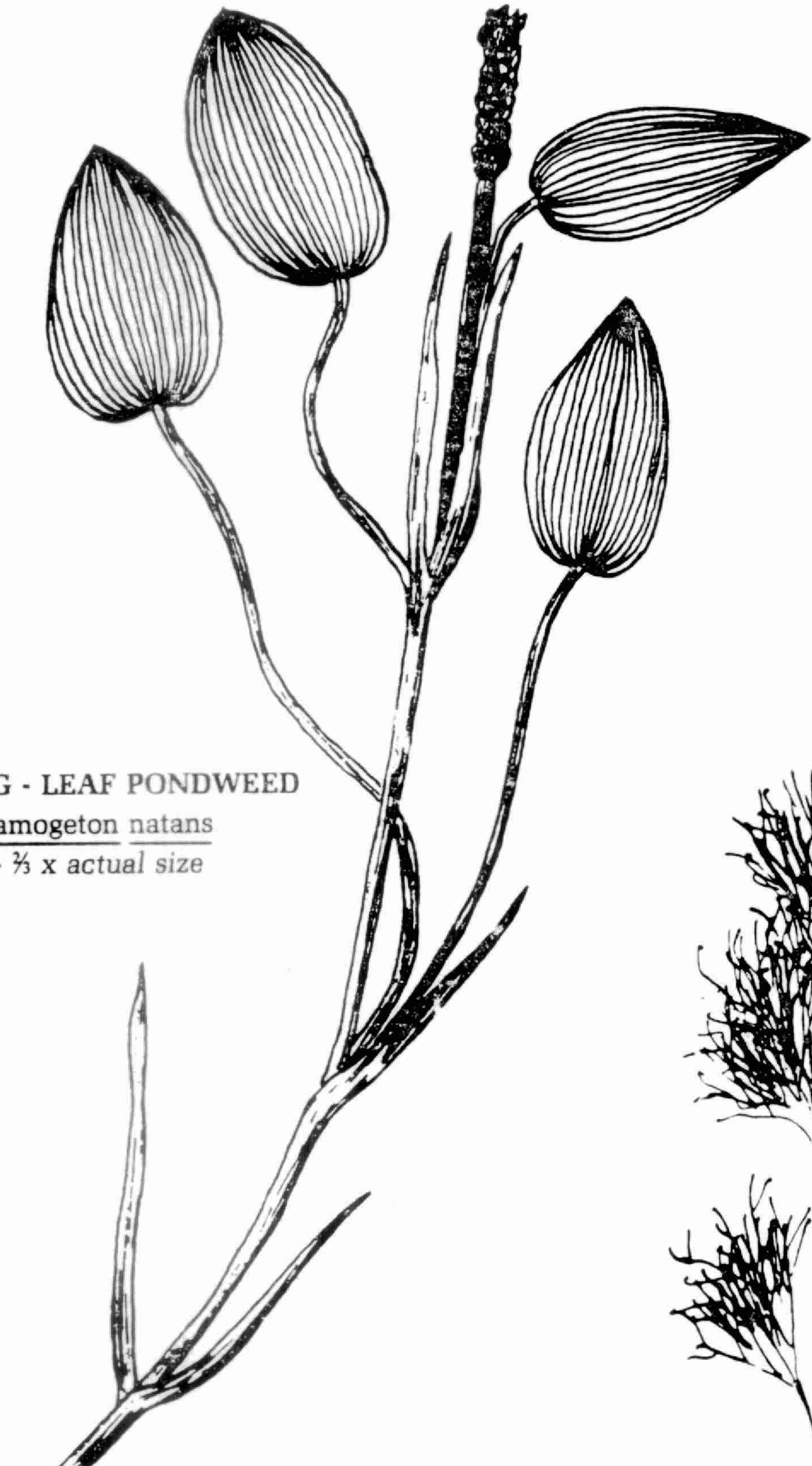
SUBMERGED VASCULAR AQUATIC PLANTS

FLAT-STEMMED PONDWEED
½ x actual size



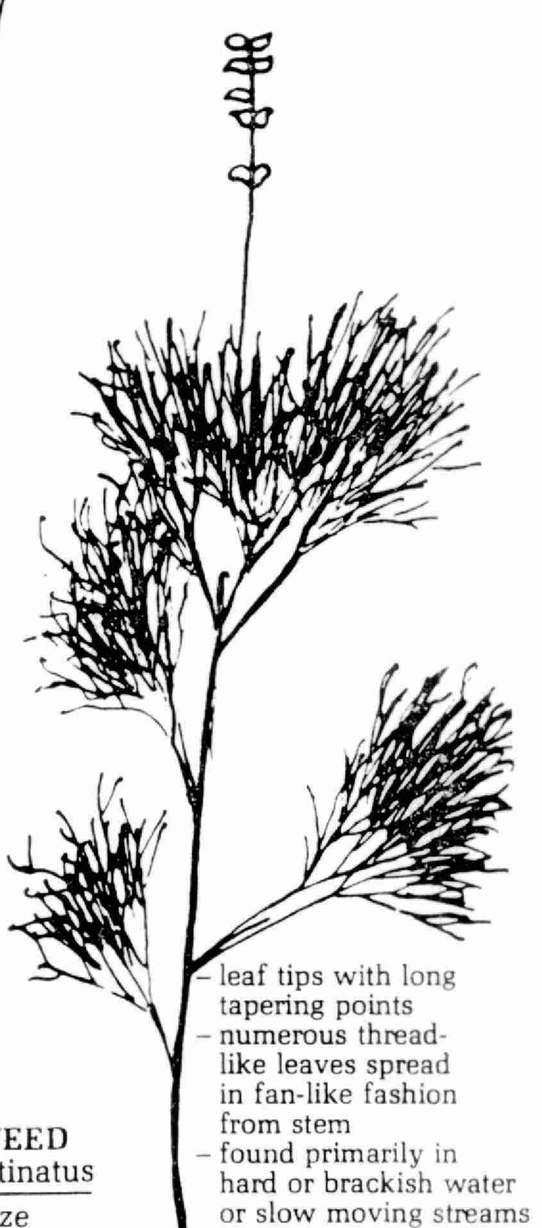
- main leaves ribbon-like and long; 1-3mm wide
- stem many-branched
- stripules delicately reined either green or white

SUBMERGED VASCULAR AQUATIC PLANTS



FLOATING - LEAF PONDWEED
Potamogeton natans
½ - ⅔ x actual size

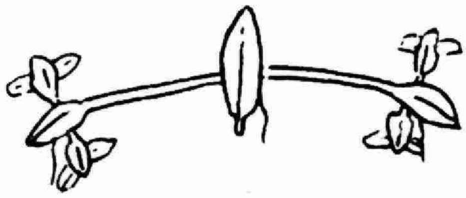
- oval brownish-green leaves float on water surface
- leaves heart-shaped at base
- flower spike usually above water surface

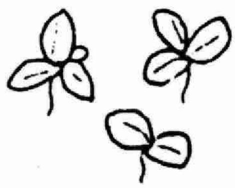


SAGO PONDWEED
Potamogeton pectinatus
½ x actual size

- leaf tips with long tapering points
- numerous thread-like leaves spread in fan-like fashion from stem
- found primarily in hard or brackish water or slow moving streams

EMERGENT AQUATIC PLANTS



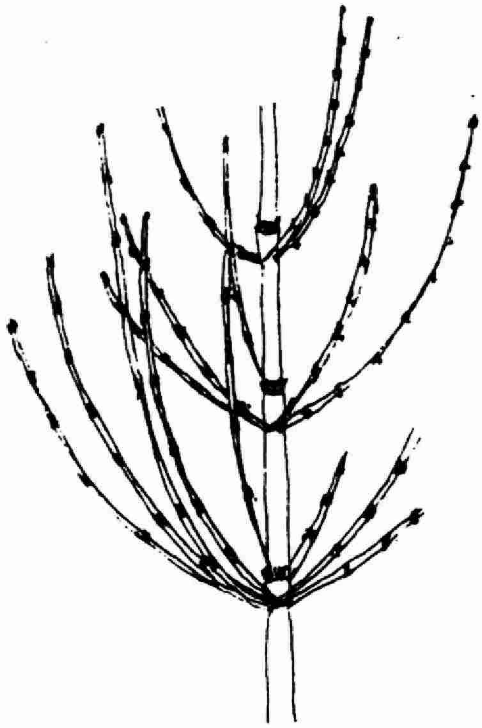


DUCKWEED
Lemna sp.

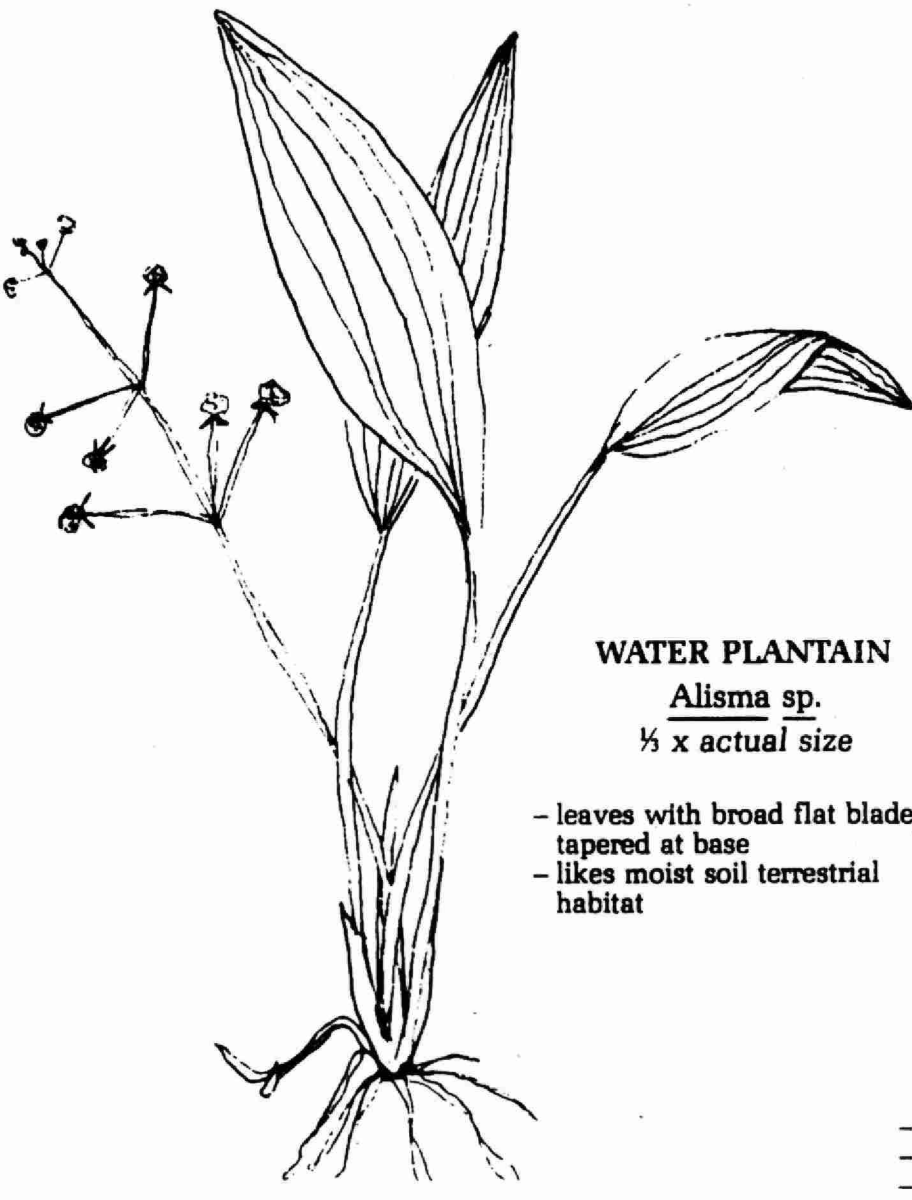
3 - 4 x actual size

- floats at or near surface of water
- hair-like roots may dangle below foliage

HORSETAIL
Equisetum sp.
½ x actual size

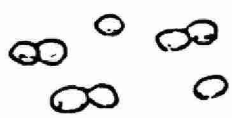


- stems hollow and pointed
- no true leaves but a whorl of slender branches from each joint



WATER PLANTAIN
Alisma sp.
⅓ x actual size

- leaves with broad flat blades, tapered at base
- likes moist soil terrestrial habitat



WATERMEAL
Wolffia sp.
4 x actual size

- floating on or near surface of water
- no roots
- microscopic meal-like (globular) bodies

EMERGENT AQUATIC PLANTS

ARROWHEAD

Sagittaria latifolia

⅓ - 1 x actual size

- veins several, of equal length
- root system very prominent and thick
- arrowhead shaped leaves
- tiny white flowers
- likes moist terrestrial environment edging lakes and marshes

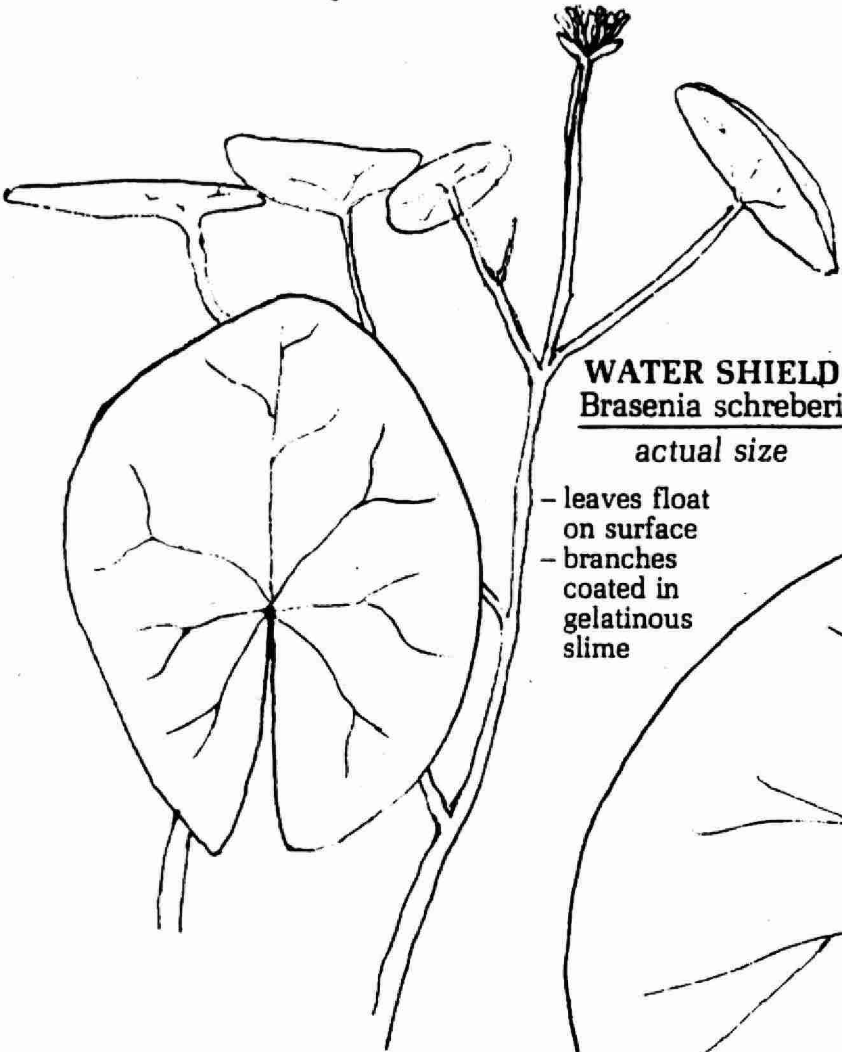
PICKERELWEED

Pontederia sp.

¼ x actual size

- bright purple flower
- found in water 2-6 cm deep; must be always wet
- heart-shaped leaves extend from base

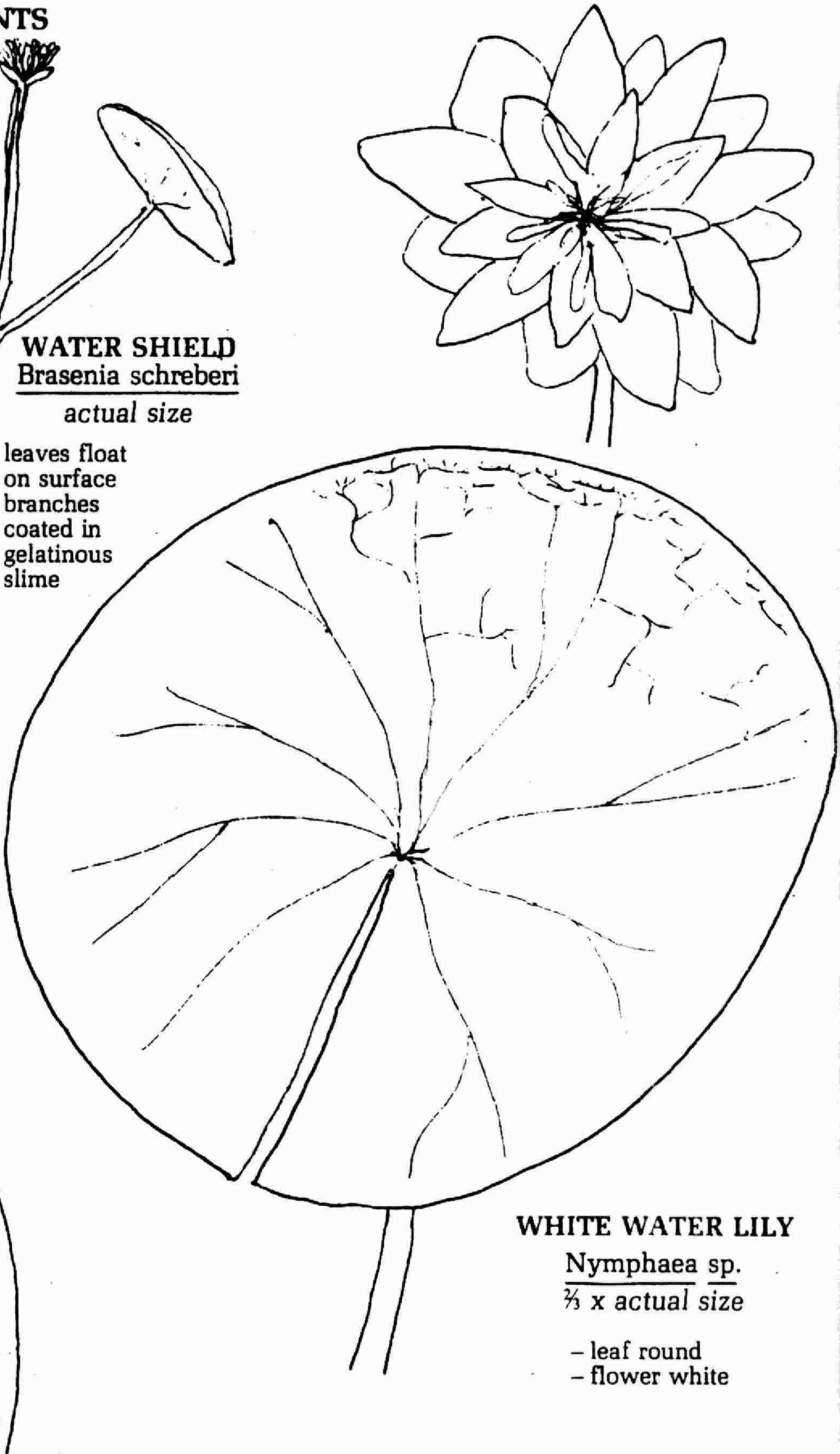
EMERGENT AQUATIC PLANTS



WATER SHIELD
Brasenia schreberi

actual size

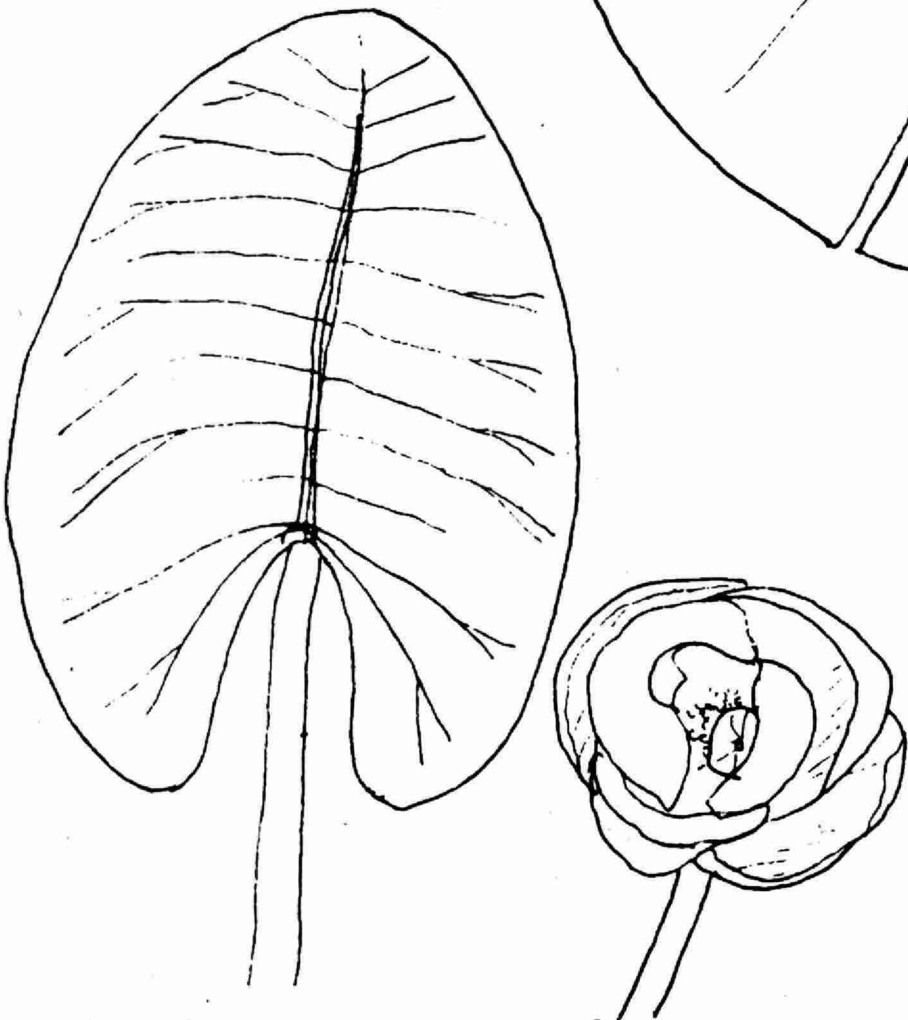
- leaves float on surface
- branches coated in gelatinous slime



WHITE WATER LILY
Nymphaea sp.

⅔ x actual size

- leaf round
- flower white

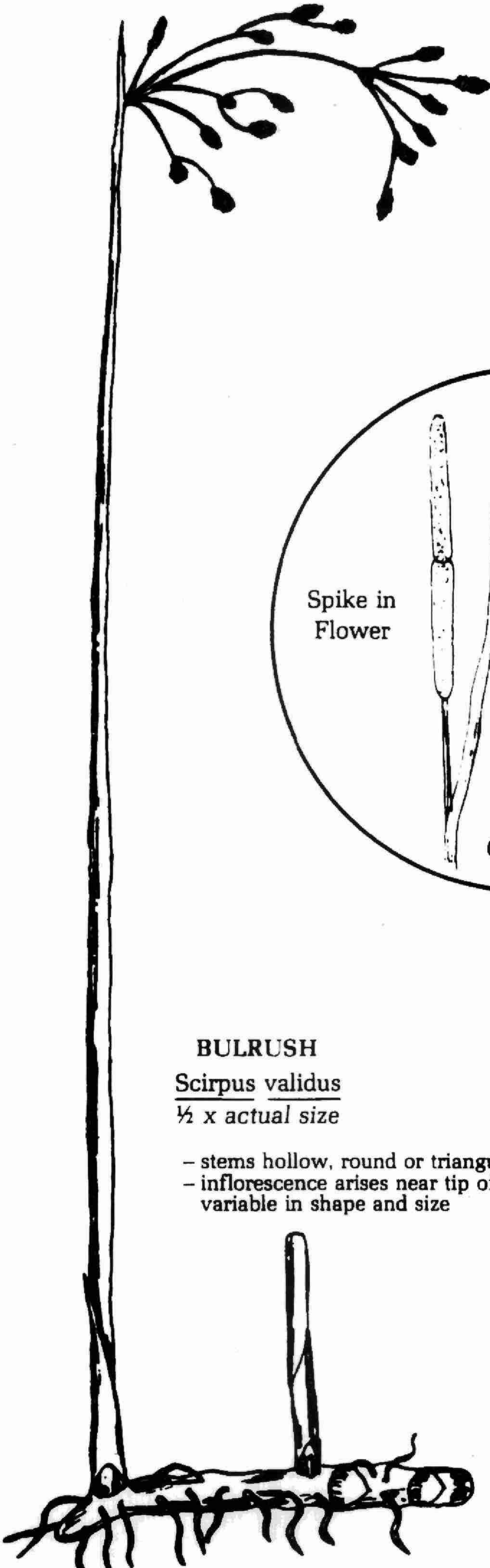


YELLOW WATER LILY OR SPATTERDOCK
Nuphar sp.

½ x actual size

- leaf oblong
- flower yellow

EMERGENT AQUATIC PLANTS



BULRUSH

Scirpus validus

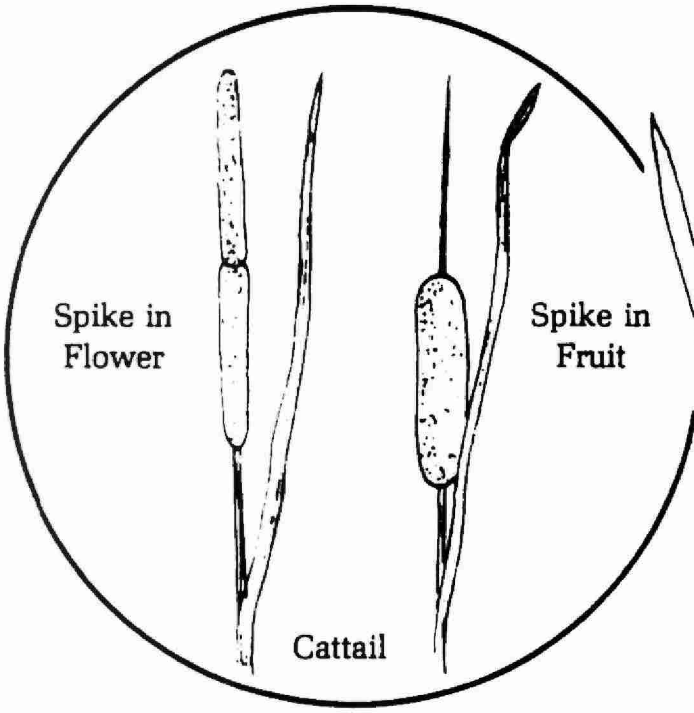
½ x actual size

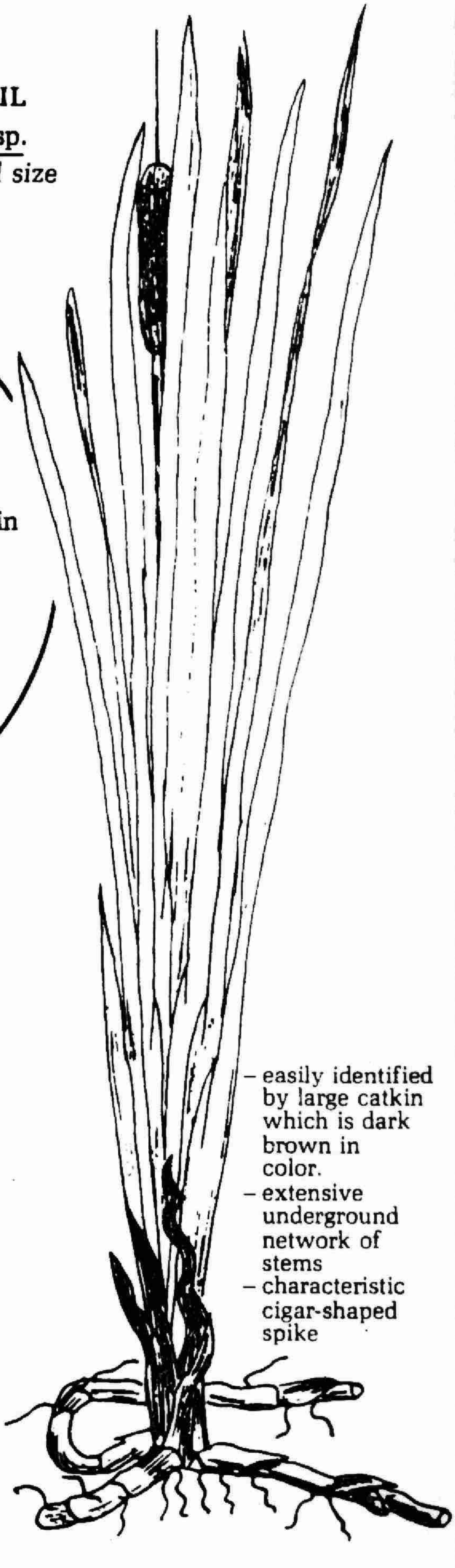
- stems hollow, round or triangular
- inflorescence arises near tip of stem, variable in shape and size

CATTAIL

Typha sp.

⅓ x actual size





- easily identified by large catkin which is dark brown in color.
- extensive underground network of stems
- characteristic cigar-shaped spike

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